PHYSICAL MODEL OF DIRAC ELECTRON. CALCULATION OF ITS MASS AT REST AND OWN ELECTRIC AND MAGNETIC INTENSITIES ON ITS MOMENT LOCATION.

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Abstract

The physical model (PhsMdl) of the relativistic quantized Dirac's electron (DrEl) is proposed, in which one be regarded as a point-like (PntLk) elementary electric charge (ElmElcChrg), taking simultaneously part in the following four disconnected different motions : a/ in Einstein's relativistic random trembling harmonic shudders as a result of momentum recoils (impulse kicks), forcing the DrEl's PntLk ElmElcChrg at its continuous emission and absorption of high energy (Hgh-Enr) stochastic virtual photons (StchVrtPhtns) by its PntLk ElmElcChrg; b/ in Schrodinger's fermion harmonic oscillations of DrEl's fine spread (FnSpr) ElmElcChrg, who minimizes the self-energy at a rest of is an electromagnetic self-action between its continuously moving FnSpr ElmElcChrg and proper magnetic dipole moment (MgnDplMmn) and the corresponding potential and vector-potential; c/in nonrelativistic Furthian quantized stochastic boson circular harmonic oscillations as a result of the permanent electris or magnetic interaction of its well spread (WllSpr) ElmElcChrg or proper MgnDplMmn with the electric intensity (ElcInt) and the magnetic intensity (MgnInt) of the resultant quantized electromagnetic field (QntElcMgnFld) of all the stochastic generated virtual photons (StchVrtPhtns) within the fluctuating vacuum (FlcVcm); d/in Nweton's classical motion along a clear-cut smooth thin line as a result of some interaction of its over spread (OvrSpr) ElmElcChrg, MgnDplMmn or bare mass with the intensities of some classical fields. If all the relativistic dynamical properties of the DrEl are results of the participate of its FnSpr ElmElcChrg in the strong correlated self-consistent Schrodinger's relativistic fermion vortical harmonic oscillations, then all the quantized dualistic dynamical properties of the SchEl are results of the participate of its WllSpr ElmElcChrg in the nonrelativistic Furthian quantized stochastic boson circular harmonic oscillations.

1   Introduction.

The successful scientific research of some natural phenomenon is very often connected with some necessary idealization and soma minimum simplification of the phenomenon under investigation. Many marvellous phenomena and remarkable properties of the sunstance have been described by help of the powerful logic of the Quantum Theory (QngThr). The physical model (PhsMdl) of some physical phenomenon presents as an actual ingradient of the physical theory (PhsThr). This is a scientific way for construction of the (PhsMdl) of the Dirac electron (DrEl). Although till now nobody knows what the elementary particle (ElmPrt) means, there exist a possibility for a obvious consideration of the unusual behaviour of all the relativistic quantized micro particle (QntMcrPrt) by means of our transparent surveyed PhsMdl of the DrEl. The

PhsMdl of the DrEl is offered in all my work in resent nineteen for bring of light to physical cause of the uncommon relativistic quantum behaviour of the DrEl and give the thru physical interpretation and sense of its dynamical parameters. It turns up that all the relativistic dynamical properties of the DrEl are results of the participate of its fine spread (FnSpr) elementary electric charge (ElmElcChrg) in the Schrodinger's self-consistent fermion strong correlated vortical harmonic oscillations, then all the quantized dynamical properties of the SchEl are results of the participate of its well spread (WllSpr) ElmElcChrg in the nonrelativistic Furthian quantized stochastic boson circular harmonic oscillations. It is used as for a obvious teaching the occurred physical micro processes within the investigated phenomena, so for doing them equal with the capacity of its mathematical correct description by the mathematical apparatus of the both the quantum mechanics (QntMch): the nonrelativistic (NrlQntMch) and relativistic (RltQntMch).

The object of this lecture is to discuss, explain and bring to light on the physical interpretation of the nonrelativistic quantum behaviour of the Schrodinger's electron (SchEl) and of the relativistic quantum behaviour of the dynamical parameters of the Dirac's electron (DrEl). The PhsMdl of the DrEl is proposed by me twenty years ago. This PhsMdl can equally explain as the physical causes for its unusual classical stochastic and so the quantum dualistic wave-corpuscular behaviour of SchEl. One gives a new cleared picturesque physical interpretation with mother wit of the physical scene of the relativistic dynamical parameters of DrEl. In our transparent surveyed PhsMdl of the DrEl one will be regarded as some point like (PntLk) ElmElcChrg, taking simultaneously part in the following four different motions: A) The isotropic three-dimensional relativistic quantized (IstThrDmnRltQnt) Einstein stochastic boson harmonic shudders (EinStchBsnHrmShds) as a result of momentum recoils (impulse kicks), forcing the charged QntMcrPrt at its continuous stochastical emissions and absorptions of own high energy (HghEnr) virtual photons (VrtPhtns) by its PntLk ElmElcChrg). This jerky motion display almost Brownian classical stochastic behaviour (BrnClsStchBhv) during a small time interval τ_1, much less then the period T of the IstThrDmnRltQnt EinStchBsnHrmShds and more larger then the time interval t of the stochastically emission or absorption of the Hgh-Enr VrtPhtn by its PntLk ElmElcChrg. In a consequence of such jerks along the IstThrDmnRltQnt EinStchBznHrmShds "trajectory" the DrEl's PntLk ElmElbChrg takes form of the fine spread (FnSpr) ElmElcChrg. B) The IstThrDmnRltQnt Schrodinger fermion vortical harmonic oscillation motion (SchFrmVrtHrmOscMtn) of the DrEl's FnSpr ElmElcChrg. In a consequence of such jerks along the EinStchHrmOscMtn "trajectory" the "trajectory" of the DrEl's FnSpr ElmElcChrg, participating in the IstThrDmnRltQnt SchFrmVrtHrmOscMtn takes a strongly broken shape. Only after the correspondent averaging over the "trajectory" of the IstThrDmnRltQnt EinStchBsnHrmShdMtn we may obtain the cylindrically spread "trajectory" of the IstThrDmnRltQnt SchFrmVrcHrmOscs' one, having got the form of the crooked figure of an eight. Only such a motion along a spread uncommon "trajectory" of the DrEl's FnSpr ElmElcChrg could through a new light over the SchEl's WllSpr ElmElcChrg's space distribution and over the spherical symmetry of the SchEl's WllSpr ElmElcChrg. This self-consistent strongly correlated IstThrDmnRltQnt SchFrmVrtHrmOscs' motion may be described correctly by means of the four components of its total wave function (TtlWvFnc) Ψ and four Dirac's matrices ; $\alpha_j\,(\gamma_j)$ and $\beta\,(\gamma_o)$.

2 Description of the relativistic quantized behaviour of the DrEl.

In this way we may do as well as make a possibility for making clear the spinor character of such a movement and all its consequences as the proper mechanical momentum (MchMmn)(spin) and the rest self-energy, fermion symmetry and fermion statistics. Only in a result of the participating the FnSpr ElmElcChrg in the IstThrDmnRltQnt SchFrmVrtHrmOscs' motion all the components of the resultant self-consistent (RslSlfCns) ElcInt of own QntElcMgnFld may be exactly compensated and have zero values and all the components of the RslSlfCns MgnInt of own QntElcMgnFld would be doubled in a comparison with the corresponding RslSlfCns values of the MgnInt of own ClsElcMgnFld of the NtnClsMcrPrt with same WllSpr ElmElcChrg, fulfilling Einstein's relativistic stochastic harmonic oscillations motion in conformity with the laws of the Einstein's relativistic classical mechanics (RltClsMch). It is turn out that in a result of own useful participation of the DrEl's FnSpr ElmElcChrg the self-energy at a rest of its electromagnetic self-action (ElcMgnSlfAct) between its continuously moving potential and vector-potential to be minimized in the with own corresponding self-consistent way. It turns up that the RslSlfCns values of the ElcInt and the MgnInt of own QntElcMgnFld of the DrEl are generated by its FnSpr ElmElcChrg, editing incessantly Hgh-Enr StchVrtPhts at different moments of the recent half period of time in its corresponding ivarious spatial positions and absorbed it in the form of the ElcMgnSlfAct in the point of the DrEl's FnSpr ElmElcChrg's instantaneous positions; C) The isotropic three-dimensional nonrelativistic quantized (IstThrDmnNrlQnt) Furthian stochastic boson vortical harmonic oscillations (FrthStchBsnVrtHrmOscs) of the SchEl as a result of the permanent electric interaction (ElcIntAct) of its WllSpr ElmElcChrg with the ElcItn of the resultant QntElcMgnFld of the low energy (LwEnr) StchVrtPhtns, stochastically generated by dint of the fluctuating vacuum (FlcVcm) in the form of exchanging StchVrtPhtns between FlcVcm and its FnSpr ElmElcChrg. This Furthian quantized stochastic uncommon behaviour of the SchEl with own participation in the random trembling motion (RndTrmMtn) is very similar to Brownian classical stochastic behaviour of the BrnClsMcrPrt with own participation in the RndTrmMtn. But in principle the exact description of the resultant behaviour of the SchEl owing of its participation in the IstThrDmnNrlQnt FrthStchBsnCrcHrmOsc motions could be done only by means of the NrlQntMch's and nonrelativistic ClsElcDnm's laws. D) The classical motion of the Lorentz's electron (LrEl) around an well contoured smooth thin trajectory which is realized in a consequence of some classical interaction (ClsIntAct) of its overspread (OvrSpr) ElmElcChrg, bare mass or magnetic dipole moment (MgnDplMnt) with the intensity of some external classical fields (ClsFlds) as in the Newton nonrelativistic classical mechanics (NrlClsMch) and in the nonrelativistic classical electrodynamics (ClsElcDnm).

In Order to understand the physical cause for the origin of the relativistic characteristics of the DrEl and some special feature of its quantum behaviour we have to investigate the participate of its FnSpr ElmElcChrg in the IstThrDmnRltQnt Schrodinger fermion vortical harmonic oscillation motion (SchFrmVrtHrmOscMtn), describing the inner structure of the SchEl. Therefore we shall try in following to describe the IstThrDmnRltQnt SchFrmVrtHrmOscMtn of the DrEl's FnSpr ElmElcChrg by means of the well-known mathematical apparatus of the RltQntMch and to give a green light of a new physical interpretation by virtue of the known language and conceptions of the NrlClsMch. We begin our new description by writing the well-known linear partial differential wave equation in partial derivative (LnrPrtDfrWvEqtPrtDrv)

of Dirac, describing the RltQntMch behaviour of the DrEl. As it is well-known there exist different representations of the LnrPrtDfrWvEqtPrtDrv of Dirac within the RltQntMch. For example we begin with the presentation of its symmetrical representation :

$$i\hbar\frac{\partial\Psi}{\partial t} = H_d\Psi = C\left(\alpha_j\hat{p}_j\right)\Psi + mC^2\beta\Psi; \tag{1}$$

where matrices α_j and β have the well-known form :

$$\alpha_j = \begin{vmatrix} \tilde{0} & \tilde{\sigma}_j \\ \tilde{\sigma}_j & \tilde{0} \end{vmatrix} \quad \text{and} \quad \beta = \begin{vmatrix} \tilde{1} & \tilde{0} \\ \tilde{0} & -\tilde{1} \end{vmatrix}; \tag{2}$$

The total wave function (TtlWvFnc) Ψ of the DrEl within the NrlQntMch, satisfying the LnrPrtDfrWvEqtPrtDrv of Dirac (1), has four components (ψ_1, ψ_2, ψ_3, ψ_4). Dirac had secured Lorentz' invariation of his LnrPrtDfrWvEqtPrtDrv by dint of the introduction of four matrices (α_1, α_2, α_3, β).

There exist also the standard representation :

$$i\hbar\frac{\partial\tilde{\Psi}}{\partial t} = \tilde{H}_d\tilde{\Psi} = C\left(\gamma_j\hat{p}_j\right)\tilde{\Psi} + mC^2\gamma_o\tilde{\Psi} \quad; \tag{3}$$

where matrices γ_j and γ_o have the well-known form :

$$\gamma_j = \begin{vmatrix} \tilde{\sigma}_j & \tilde{0} \\ \tilde{0} & -\tilde{\sigma}_j \end{vmatrix} \quad \text{and} \quad \gamma_o = \begin{vmatrix} \tilde{0} & \tilde{1} \\ \tilde{1} & \tilde{0} \end{vmatrix} \tag{4}$$

In order to understand the physical meaning of the both TtlWvFnc Ψ and $\tilde{\Psi}$ we must rewrite the both LnrPrtDfrWvEqnsPrtDvt of DrEl (1) and (3) in their component forms. In such a way we may write the following system of the motion equations :

$$i\hbar\frac{\partial\varphi}{\partial t} = C\left(\sigma_j\hat{P}_j\right)\chi + mC^2\varphi; \ i\hbar\frac{\partial\chi}{\partial t} = C\left(\sigma_j\hat{P}_j\right)\varphi - mC^2\chi; \tag{5}$$

$$i\hbar\frac{\partial\eta}{\partial t} = C\left(\sigma_j\hat{P}_j\right)\eta + mC^2\lambda; \ i\hbar\frac{\partial\lambda}{\partial t} = -C\left(\sigma_j\hat{P}_j\right)\varphi + mC^2\eta; \tag{6}$$

The eqs.(5) and (6) have been written by virtue of the following useful designations of the component sets of both the TtlWvFcs Ψ and $\tilde{\Psi}$:

$$\varphi = \begin{vmatrix} \psi_1 \\ \psi_2 \end{vmatrix}; \quad \text{and} \quad \chi = \begin{vmatrix} \psi_3 \\ \psi_4 \end{vmatrix}; \quad \text{or} \quad \eta = \begin{vmatrix} \tilde{\psi}_1 \\ \tilde{\psi}_2 \end{vmatrix}; \quad \text{and} \quad \lambda = \begin{vmatrix} \tilde{\psi}_3 \\ \tilde{\psi}_4 \end{vmatrix}; \tag{7}$$

As it is following from (5) the total energy of the DrEl at its forward motion $i\hbar\frac{\partial\varphi}{\partial t}$ is equal of the sum of its kinetic energy $C\left(\tilde{\sigma}_j\tilde{P}_j\right)$ in the state , χ and potential energy $m.C^2$ of its ElcMgnSlfAct of its FnSpr ElmElcFld with a corresponding resultant own QntElcMgnFld, created by the StchVrtPhtns, radiated by its FnSpr ElmElcChrg in the state φ. Just in such a way about the total energy of the DrEl $i\hbar\frac{\partial\chi}{\partial t}$ is equal of the sum of its kinetic energy $C\left(\tilde{\sigma}_j\tilde{P}_j\right)$ in the state φ and potential energy $m.C^2$ of its ElcMgnSlfAct of its FnSpr ElmElcFld with a corresponding resultant own QntElcMgnFld, created by the StchVrtPhtns, radiated by its FnSpr ElmElcChrg in the state χ. That is because we may flatly assert that the components φ of its TtlWvFnc Ψ in the symmetrical presentation describe the forward motion of the DrEl and

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the components χ of the same TtlWvFnc describe the backward motion of the DrEl. Besides that if the both odd components: Ψ_1 and Ψ_3 describe the DrEl's spinning in a left, then both even components : Ψ_2 and Ψ_4 describe the DrEl's spinning in a right. Therefore these two group WvFnc have opportunity sign before the angle φ are transforming separately.

The existence relations between both TtlWvFnc Ψ and $\tilde{\Psi}$ give us a clear physical explanation and correct mathematical description of all components of the DrEl's TtlWvFnc in the both representation. From the LnrPrtDfrWvEqtPrtDrv of Dirac we may see that matrixes work within its as switches, making possible the correct mathematical description of the IstThrDmnRltQnt SchFrmVrtHrmOscMtn of the DrEl's FnSpr ElmElcChrg by dint of the four components of its TtlWvFnc.

In a due course it is easily to show further that the proper mechanical moment (PrpMchMmn)(spin) of the DrEl can really be created as a result of the participate of its FnSpr ElmElcChrg in the IstThrDmnRltQnt SchFrmVrtHrmOscMtn. In order to obtain this in a naturally way we have to rewrite the four one-component LnrPrtDfrWvEqtPrtDrv of Dirac (5) in more obvious form :

$$i\hbar \frac{\partial \psi_1}{\partial t} + i\hbar C \times \left\{ \frac{\partial \psi_4}{\partial x} - i\frac{\partial \psi_4}{\partial y} + \frac{\partial \psi_3}{\partial z} \right\} = mC^2 \psi_1 \,;$$

$$i\hbar \frac{\partial \psi_2}{\partial t} + i\hbar C \times \left\{ \frac{\partial \psi_3}{\partial x} + i\frac{\partial \psi_3}{\partial y} - \frac{\partial \psi_4}{\partial z} \right\} = mC^2 \psi_2 \,;$$

$$i\hbar \frac{\partial \psi_3}{\partial t} + i\hbar C \times \left\{ \frac{\partial \psi_2}{\partial x} - i\frac{\partial \psi_2}{\partial y} + \frac{\partial \psi_1}{\partial z} \right\} = -mC^2 \psi_3 \,;$$

$$i\hbar \frac{\partial \psi_4}{\partial t} + i\hbar C \times \left\{ \frac{\partial \psi_1}{\partial x} + i\frac{\partial \psi_1}{\partial y} - \frac{\partial \psi_2}{\partial z} \right\} = -mC^2 \psi_4 \,; \qquad (8)$$

Then the system of four one-component LnrPrtDfrWvEqtPrtDrv of Dirac (5) may be rewritten by means of the substitution : $x = \rho \cos\phi$ and $y = \rho \sin\phi$; from Decart's coordinates in more obvious form of cylindrical coordinates :

$$i\hbar \frac{\partial \psi_1}{\partial t} + i\hbar C \left[\exp{-i\phi} \left\{ \frac{\partial \psi_4}{\partial \rho} - \frac{i}{\rho}\frac{\partial \psi_4}{\partial \phi} \right\} + \frac{\partial \psi_3}{\partial z} \right] = mC^2 \psi_1 \,;$$

$$i\hbar \frac{\partial \psi_2}{\partial t} + i\hbar C \left[\exp{+i\phi} \left\{ \frac{\partial \psi_3}{\partial \rho} + \frac{i}{\rho}\frac{\partial \psi_3}{\partial \phi} \right\} + \frac{\partial \psi_4}{\partial z} \right] = mC^2 \psi_2 \,;$$

$$i\hbar \frac{\partial \psi_3}{\partial t} + i\hbar C \left[\exp{-i\phi} \left\{ \frac{\partial \psi_2}{\partial \rho} - \frac{i}{\rho}\frac{\partial \psi_2}{\partial \phi} \right\} + \frac{\partial \psi_1}{\partial z} \right] = -mC^2 \psi_3 \,;$$

$$i\hbar \frac{\partial \psi_4}{\partial t} + i\hbar C \left[\exp{+i\phi} \left\{ \frac{\partial \psi_1}{\partial \rho} + \frac{i}{\rho}\frac{\partial \psi_1}{\partial \phi} \right\} - \frac{\partial \psi_2}{\partial z} \right] = -mC^2 \psi_4 \,; \qquad (9)$$

As it is easily to seen if the first pair of TtlWvFnc's components ψ_1 and ψ_3 have equal phase factors ϕ_1, than the second the pair of TtlWvFnc's components ψ_2 and ψ_3 have also equal phase factors $-\phi_1$. As it follows from eq.(9) the difference between two phase factors is equal of ϕ. Therefore we may suppose by means of a symmetrical consideration that four components (OrbWvFnc) of the DrEl's TtlWvFnc Ψ have the following presentations :

$$\psi_1(\rho,\phi,z) = \bar{\psi}_1(\rho,\phi,z)\exp{-i(\phi/2)}\,; \quad \psi_3(\rho,\phi,z) = \bar{\psi}_3(\rho,\phi,z)\exp{-i(\phi/2)}\,; \qquad (10)$$

$$\psi_2(\rho,\phi,z) = \bar{\psi}_2(\rho,\phi,z)\exp{+i(\phi/2)}\,; \quad \psi_4(\rho,\phi,z) = \bar{\psi}_4(\rho,\phi,z)\exp{+i(\phi/2)}\,; \qquad (11)$$

If we take into account that the participate of the well spread (WllSpr) ElmElcChrg of the SchEl in the IstThrDmnRltQnt FrthStchBsnCrcHrmOscMtn, securing its quantum behavior secures an additional dispersion $(\delta\phi/2)$, then the TtlWvFnc Ψ of the DrEl can be rewritten in two following representations :

$$\Psi_{l+1/2}\left(\rho,\phi,z\right) = \frac{\phi_o}{2} \begin{vmatrix} \psi_{1l}\left(\rho,z\right)\exp il\phi \\ \psi_{2l}\left(\rho,z\right)\exp i(l+1)\phi \\ \psi_{3l}\left(\rho,z\right)\exp il\phi \\ \psi_{4l}\left(\rho,z\right)\exp i(l+1)\phi \end{vmatrix} \tag{12}$$

and

$$\Psi_{l-1/2}\left(\rho,\phi,z\right) = \frac{\phi_o}{2} \begin{vmatrix} \psi_{1l}\left(\rho,z\right)\exp i(l-1)\phi \\ \psi_{2l}\left(\rho,z\right)\exp il\phi \\ \psi_{3l}\left(\rho,z\right)\exp i(l-1)\phi \\ \psi_{4l}\left(\rho,z\right)\exp il\phi \end{vmatrix} \tag{13}$$

In the meanwhile it is easily to verify by virtue of the operator

$$\hat{J}_z = \left\{ -i\hbar\frac{\partial}{\partial\phi} + \frac{\hbar}{2}\sigma_z \right\} \tag{14}$$

that if the TtiWvFnc (12) describes the behaviour of the free DrEl, having the TtiMchMmn's value $J_z = \hbar\left(l+1/2\right)$, than the TtiWvFnc (13) describes the behaviour of the free DrEl, having the TtiMchMmn's value $J_z = \hbar\left(l-1/2\right)$. Indeed, if

$$\hat{J}_z\,\Psi_{l+1/2}\left(\rho,\phi,z\right) = \frac{\phi_o}{2} \begin{vmatrix} \hbar\left(l+1/2\right)\psi_{1l}\left(\rho,z\right)\exp il\phi \\ \hbar\left(l+1-1/2\right)\psi_{2l}\left(\rho,z\right)\exp i(l+1)\phi \\ \hbar\left(l+1/2\right)\psi_{3l}\left(\rho,z\right)\exp il\phi \\ \hbar\left(l+1-1/2\right)\psi_{4l}\left(\rho,z\right)\exp i(l+1)\phi \end{vmatrix} = \hbar\left(l+1/2\right)\Psi_{l+1/2}\left(\rho,\phi,z\right) \tag{15}$$

and

$$\hat{J}_z\,\Psi_{l-1/2}\left(\rho,\phi,z\right) = \frac{\phi_o}{2} \begin{vmatrix} \hbar\left(l-1+1/2\right)\psi_{1l}\left(\rho,z\right)\exp i(l-1)\phi \\ \hbar\left(l-1/2\right)\psi_{2l}\left(\rho,z\right)\exp il\phi \\ \hbar\left(l-1+1/2\right)\psi_{3l}\left(\rho,z\right)\exp i(l-1)\phi \\ \hbar\left(l-1/2\right)\psi_{4l}\left(\rho,z\right)\exp il\phi \end{vmatrix} = \hbar\left(l-1/2\right)\Psi_{l-1/2}\left(\rho,\phi,z\right) \tag{16}$$

The presented upper investigation shows us that the FnSpr ElmElcChrg of the DrEl really participates in the IstThrDmnRltQnt SchFrmVrtHrmOscMtn and the WllSpr ElmElcChrg of the SchEl really participates in the IstThrDmnRltQnt FrthStchBsnCrcHrmOscMtn. In what following we wish to show that the participating the FnSpr ElmElcChrg in its self-consistent IstThrDmnRltQnt SchFrmVrtHrmOscMtn (Zitterbevegung) is very effective at creation of its own resultant self-consistent quantized electromagnetic field (QntElcMgnFld) by means of stochastic emission of the VrtPhtns.

In the first Breit and afterwards Fock had observed that the instantaneous velocity operator $\frac{\partial\hat{r}_j}{\partial t}$ assume, that the operator of the instantaneous velocity of a free QntMcrPrt have very paradoxical form in the RltQntMch. Indeed, it is well-known from the RltQntMch that the analytical operator form of the instantaneous velocity value of the free DrEl may be obtained

by virtue of the Heisenberg commutation relations between the operators of its radius-vector $\hat{r}_j$ and Dirac's hamiltonian H_d. In such the way we can obtain:

$$\hat{V}_j = \frac{d\,\hat{r}_j}{d\,t} = -\frac{i}{\hbar}\,(\,\bar{r}_j\,\bar{H}_d - \bar{H}_d\,\bar{r}_j\,) = C\,\alpha_j;\qquad(17)$$

Seventy years ago Schrodinger had investigated the physical meaning of the operators in the RltQntMch, describing the relativistic quantized behaviour of the DrEl in the old Dirac picture, making use of its linear Hamiltonian, LnrPrtDfrWvEqtPrtDrv of Dr and four component TtlWvFnc $\Psi(r, t)$. First of all he had obtained the motion equation for Dirac's matrices :

$$i\,\hbar\frac{\partial\alpha_j}{\partial t} = (\,\alpha_j\,H_d - H_d\,\alpha_j\,) = 2\,(\,\alpha_j\,H_d - C\,\hat{p}_j\,) = 2\,(\,C\,\hat{p}_j - \alpha_j\,H_d\,);\qquad(18)$$

After replacing in the equation (18) the matrices α_j by the matrices η_j according to the following equation :

$$\eta_j = \left(\alpha_j - \frac{C\hat{p}_j}{H_d}\,I_o\right)\quad;\qquad(19)$$

Schrodinger had obtained the oscillation equation for η matrices. In such a way he had obtained the following solution of eq.(17) for $r(t)_j$:

$$\hat{r}_j = \hat{a}_j + \frac{tC^2\hat{p}_j}{H_d}\,I_o + \frac{i\,C\,\hbar}{H_d}\left(\alpha_j - \frac{C\hat{p}_j}{H_d}\,I_o\right)_{t=o}\exp\left\{\frac{2itH_d}{\hbar}\right\};\qquad(20)$$

From eq.(20) we can see that the second term describes the classical motion of the free ClsMcrPrt and one increases in a linear way with the current velocity when the time is increasing. The last term η in the eq.(20) describes the self-consistent inner motion of the FnSpr ElmElcChrg of the DrEl, which had called Zitterbewegung by Schrodinger. As would be understand the participation of the SchEl's WllSpr ElmElcChrg in the IstThrDmnNrlQnt FrthStchBsnCrcHrmOscsMtm is not described by its OrbWvFnc and therefore there are no own part in the coordinate operator (20). The participation of the DrEl's FnSpr ElmElcChrg in the IstThrDmnRltQnt SchFrmVrtHrmOscMtn, which is well described by the Dirac's matrices α_j and the four components of the DrEl's total wave function (TtlWvFnc), directs us to construct a new matrix' RltQntElcDnm in an accordance with the Maxwell's nonrelativistic ClsElcDnm, where the classical motion of some NtnClsPrt is described with the smooth thin line. Moreover, as it will be obvious in the following investigation there exists a possibility to understand the physical reasons of the rest self-energy origin and the physical interpretation of the LnrPrtDfrWvEqt of Dirac.

Indeed, we shall demonstrate in the what following that because of the participation of the DrEl's FnSpr ElmElcChrg in its IstThrDmnRltQnt SchFrmVrtHrmOsc motion, there exists a possibility to calculate also the instantaneous RslSlfCns values of all the components of the ElcInt E_j and of the MgnInt H_j of the own resultant QntElcMgnFld in the point of its instantaneous position by means of the Dirac's matrices, describing this self-consistent motion. As it was shown above the RslQwn QntElcMgnFld is begotten by Hgh-Enr StchVrtPhtns, emitted by its FnSpr ElmElcChrg in different time moments from corresponding different space positions, being occupied by its FnSpr ElmElcChrg during the last half-period.

Indeed, for long time (about one centaur) ago, thence R.Schwarzschild had written the electro-kinetic term $\rho(\varphi - v.A)$ into the Lagranjian density, it is well-known from the Maxwell

ClsElcDnm that when the LrEl is found in the external ClsElcMgnFld its canonical impulse p_j amounts in two parts :

$$P_j = p_j^k + p_j^p = m\,v_j - \frac{e}{C}\,A_j\,;\; W = E - \frac{e}{C}\,\varphi\,; \tag{21}$$

The first part $p_j^k = m\,v_j$ is the well-known kinematic momentum and the second part $p_j^p = -\frac{e}{C}\,A_j$ is the potential momentum, which the DrEl with his FnSpr ElmElcChrg have acquired when it was brought in some external ClsElcMgnFld. Therefore the uncommon behaviour of the SchEl in the external QntElcMgnFld may be described as the behavior of the free one, only replacing the canonical impulse operator $\hat{p}_j = -i\,\hbar\,\nabla_j$ with its generalized impulse P_j and generalized energy W, described in the following form (21):

$$\hat{P}_j = \hat{p}_j - \frac{e}{C}\,\hat{A}_j\,;\; \hat{W} = \hat{E} - \frac{e}{C}\,\hat{\varphi}\,; \tag{22}$$

with canonical impulse operator $\hat{P}_j = -i\,\hbar\,\nabla_j$ and canonical energy operator $\hat{W} = i\,\hbar\,\frac{\partial}{\partial t}$. For the sake of the intrinsic symmetry it is convenient to make use of the generalized impulse of its zero component P_o instead of $\frac{\hat{W}}{C}$ and of the mechanical impulse of its zero component p_o instead of $\frac{\hat{E}}{C}$. However it is easy to verify that if all the components of the canonical impulses commute between them-selves :

$$\hat{P}_j\,\hat{P}_l - \hat{P}_l\,\hat{P}_j = \delta_{jl}\,;\quad and \quad \hat{P}_j\,\hat{P}_o - \hat{P}_o\,\hat{P}_j = \delta_{jo}\,; \tag{23}$$

then all the components of the kinetic impulse don't commute between oneself. It is turned out that the commutations between the mechanical (kinematic) impulse generate the values of the ElcInt E_j and the MgnInt H_j of the external ClsElcMgnFld, as it is well-known from the NrlQntMch. Indeed,if we rewrite the eqs. (22) in the following form :

$$-i\,\hbar\,\nabla_j = \hat{p}_j - \frac{e}{C}\,\hat{A}_j = m\,\hat{v}_j - \frac{e}{C}\,\hat{A}_j\,; \tag{24}$$

and

$$i\,\frac{\hbar}{C}\,\frac{\partial}{\partial t} = \hat{p}_o - \frac{e}{C}\,\hat{A}_o = \frac{\hat{E}}{C} - \frac{e}{C}\,\hat{\varphi}\,; \tag{25}$$

then the four commutations between the four mechanical (kinematic) impulse components generate the six values of the ElcInt E_j and of the MgnInt H_j of the external ClsElcMgnFld, as it is well-known from the NrlQntMch :

$$\hat{p}_j\,\hat{p}_l - \hat{p}_l\,\hat{p}_j = m\,\hat{v}_j\,m\,\hat{v}_l - m\,\hat{v}_l\,m\,\hat{v}_j = i\,\hbar\,\frac{e}{C}\,\varepsilon_{jlk}\,H_k\,; \tag{26}$$

and

$$\hat{p}_j\,\hat{p}_o, -\hat{p}_o\,\hat{p}_j = m\,\hat{v}_j\,m\,hatv_o - m\,\hat{v}_o\,m\,\hat{v}_j = i\,\hbar\,\frac{e}{C}\,E_j\,; \tag{27}$$

The six components values of the ElcInt E_j and the MgnInt H_j of the external QntElcMgn-Fld are determined for the space position r_j of the WllSpr ElmElcChrg of the SchEl (from the NrlClsMch's point of view) at the time moment t.Indeed, there aren't any mistake in our physical interpretation. Indeed, we have to remember that the IstThrDmnNrlQnt FrthStchB-snCrcHrmOscs' motion is a result of the permanent interaction of the WllSpr ElmElcChrg of the SchEl with the ElcInt E_j of the StchVrtPhtns, generated in the neighbour area of its localization by the FlcVcm. Hence as the IstThrDmnNrlQnt FrthStchBsnCrcHrmOscs'motion

of the QntMcrPrt has no a thin and smooth classical trajectory, which may be determined as a solution of the Newton equation, then we are forced to take advantage of results of the Heisenberg commutations (26) and (27). Moreover we have no right to take into account the screening influence of the FlcVcm over the ElcInt at the description of the ElcMgmSlfInt of the FnSpr ElmElcChrg and MgnDplMmn of the DrEl with the RslSlfCns values of the ElcInt and the MgnInt of own resultant QntElcMgnFld as we already use it at taking into account its influence at the description of the SchEl's participation in the IstThrDmnNrlQnt FrthStchB-snCrcHrmOsc's motion.

Consequently, the vector-potential $\breve{A}_j$ and potential $\breve{V}_j$, which takes part within the Lnr-PrtDfrWvEqt of Dirac don't contain any contribution of the existent StchVrtPhtns within the FlcVcm. However on other hand it is known from the RltQntMch too that the operator of the instantaneous velocity V_j of the free FnSpr DrEl has the exceptional form $C\alpha_j$ as it is seen from eq.(17). Therefore if we want to describe correctly the IstThrDmnRltQnt SchFrmVrtHrmOsc's motion of the free DrEl, who is moving by its instantaneous velocity $\hat{V}_j = C\,\alpha_j$ within own resulting QntElcMgnFld by virtue of the mathematical apparatus of the RltQntMch, we must take use of the well-known Heisenberg commutation relations (26) and (27). Therefore we may suppose that the DrEl's generalized moments in the RltQntMch could be determined by Dirac's matrices as they ware done the velocity was exchange by $C\alpha_j$ in the same eqs.(20). Then we have obtain the following presentation of the DrEl's mechanical momentum components in the motionless coordinate system of reference relatively to the centre of the space distribution of the SchEl's WllSpr ElmElcChrg :

$$\breve{p}_o = m\,C\,\hat{I}\,; \quad \text{and} \quad \breve{p}_j = m\,C\,\alpha_j\,; \tag{28}$$

where $\breve{I}$ denotes the unitar matrix. Hence the HsnCmtRlt between the kinetic momentum components (28) of the DrEl in the RltQntMch, which are analogous of the HsnCmtRlt for the SchEl to eqs.(26) and (27). have to determine the RslSlfCns values of the ElcInt $\breve{E}_j$ and the MgnInt $\breve{H}_j$ of own QntElcMgnFld. Therefore they may be written in the following form :

$$\breve{p}_j\,\breve{p}_l - \breve{p}_l\,\breve{p}_j = m^2\,C^2\,(\,\alpha_j\,\alpha_l - \alpha_l\,\alpha_j\,) = 2\,i\,m^2\,C^2\,\varepsilon_{jlk}\,\sigma_k\,; \tag{29}$$

and

$$\breve{p}_j\,\breve{p}_o - \breve{p}_o\,\breve{p}_j = m^2\,C^2\,(\,\alpha_j\,\hat{I} - \hat{I}\,\alpha_j\,) = 0\,; \tag{30}$$

if the commutations (26) and (27) between the mechanical (kinematic) impulse $\hat{p}_j$, $\hat{p}_l$ and $\hat{p}_o$ generate the AvrVls $\hat{E}_j$ and $\hat{H}_j$ of the ElcInt and MgnInt of the external QntElcMgnFld, then the commutations (29) and (30) between the mechanical (kinematic) impulse $\breve{p}_j$, $\breve{p}_l$ and $\breve{p}_o$ generate the PslSlfCnsVls $\breve{E}_j$ and $\breve{H}_j$ of the ElcInt and the MgnInt of the own resultant QntElcMgnFld, which may be obtained by means of the comparison of the corresponding right parts of the (26), (27) and (29), (30) and one may be described by the following formulas :

$$\breve{E}_j = 0\,; \quad \text{and} \quad \breve{H}_j = 2\,\frac{m^2\,C^3}{e\,\hbar}\sigma_j\,; \tag{31}$$

In such an easy way only owing to a supposition of the self-consistency of IstThrDmnRltQnt SchFrmVrtHrmOsc's motion of the DrEl's FnSpr ElmElcChrg at about the light velocity C, who minimizes in a self-consistent way the self-energy at a rest of its electromagnetic self-acting (ElcMgnSlfAct) between its continuously moving FnSpr ElmElcChrg and the corresponding electric current with their corresponding potential and vector-potential. The RslSlfCnsVls of

own QntElcMgnFld of the DrEl is created by its FnSpr ElmElcChrg, emitting incessantly high energy StchVrtPhtns at different moments of the latest time from its various corresponding positions in a space and absorbed in the form of the ElcMgnSlfAct by the DrEl's FnSpr ElmElcChrg in its instantaneous positions. All the RslSlfCnsVls of the ElcInt components $\check{E}_j$ of own QntElcMgnFld may be precisely compensated in a result of the participation of the DrEl's FnSpr ElmEl in same IstThrDmnRltQnt SchFrmVrtHrmOscsMtn. Only in a result of such the IstThrDmnRltQnt SchFrmVrtHrmOsc's motion all the RslSlfCns values of the MgnInt components $\check{H}_j$ of own QntElcMgnFld may obtain double values in a comparison with the corresponding averaged values of the MgnInt components $\hat{H}_j$ of the ClsElcMgnFld of some NtnClsPrt, charged by the FnSpr ElmElcChrg, fulfilled the IstThrDmnRltQnt BsnStchCrcHrmOsc's motion in a conformity with the laws of the Einstein relativistic classical mechanics (RltClsMch).

The Schrodinger's zitterbewegung is a self-consistent strong correlated vortical motion, which minimizes the self-energy at a rest of the QntMcrPrt and one secures the continuous stability of its Shrodinger's wave package (SchWvPct) in time within the space. Therefore this inner self-consistent quantized vortical motion of the QntMcrPrt's FnSpr ElmElcChrg corresponds to its inner harmonical motion, introduced firstly by Louis de Broglie.

There exists some possibilities enough not only for rough calculations of the averaged undivergent potential and vector-potential of the DrEl's FnSpr ElmElcChrg and real values of its particular MgnDplMm μ_j and MchMmn s_j, which are results of the participation of the DrEl's FnSpr ElmElcChrg in its IstThrDmnRltQnt SchFrmVrtHrmOsc's motion. This natural conclusion explains the physical cause of the doubled gyromagnetical ratio of the DrEl's inner MgnDplMmn $\mu_j = \frac{-e\hbar}{2mC}\sigma_j$ to its inner MchMmn (spin) $S_j = \frac{\hbar}{2}\sigma_j$ and abolishes the necessity of useless renormalization of its ElcChrg and mass because of the absence of any physical substantiations, as will be seen in further researches. Hence the magnetic productivity of the DrEl's FnSpr ElmElcChrg as a result of its participation in the IstThrDmnRltQnt SchFrmVrtHrmOsc's motion exceeds in twice the magnetic productivity of the SchEl's WllSpr ElmElcChrg as a result of its participation of IstThrDmnNrtQnt FrthStchBsnHrmOsc's motion with same parameters.

In the proposed PhsMdl of the DrEl its rest energy $m.C^2$ may be considered as a natural consequence to the ElcMgnSlfAct between its RslSlfCns values of the MgnInt $\check{H}_j = 2(\frac{m^2C^3}{e\hbar})\sigma_j$ of the own QntElcMgnFld in the point of its instantaneous position and the RslSlfCns values of its MgnDplMmn $\mu_j = (\frac{-e\hbar}{2mC})\sigma_j$ at same point :

$$E_o = -\langle \mu_j \rangle \langle \check{H}_j \rangle = \frac{e\hbar}{2mC}\langle \sigma_j \rangle \frac{2m^2C^3}{e\hbar}\langle \sigma_j \rangle = mC^2\langle \sigma_j \rangle\langle \sigma_j \rangle = m\,C^2\,; \qquad (32)$$

Indeed, it is easy to verify that :

$$\langle \sigma_j \rangle \langle \sigma_j \rangle = \sin^2\theta\,cos^2\phi + \sin^2\theta\,sin^2\phi + cos^2\theta = 1\,; \qquad (33)$$

As a result of the above investigation we can affirm that the participation of the SchEl's WllSpr ElmElcChrg in IstThrDmnNrlQnt FrthStchCrcBsnHrmOscMtn cause existence of its anomalous MgnDplMmn $\delta\mu_o$. Therefore if we wish to obtain a ratio of the anomalous MgnDplMmn $\delta\mu_o$ of the SchEl's WllSpr ElmElcChrg as a result of its participate in the IstThrDmnNrlQnt FrthStchCrcBsnHrmOscMtn to its own MgnDplMmn μ_o as a result of the participation of DrEl's FnSpr ElmElcChrg in the IstThrDmnNrlQnt SchFrmHrmOscMtn, then we must know that it is equal to half ratio of their kinetic energies. Consequently as a result of the natural

relations we can obtain :

$$\frac{\delta\mu_o}{\mu_o} = \frac{1}{2\pi}\frac{e^2}{C\hbar}\frac{mC^2}{mC^2}; \quad and \quad \delta\mu_o = \frac{\mu_o}{2\pi}\frac{e^2}{C\hbar}; \tag{34}$$

In a consequence of the above used approach we may propose that the RslSlfCns values of the four components of the vector-potential $\check{A}_j$ and potential $\check{\phi}$ of the DrEl's FnSpr ElmElcChrg, participating in the IstThrDmnNrlQnt SchFrmVrtHrmOsc's motion, one have the following analytic form :

$$\langle\,\check{A}_j\,\rangle = \frac{m.C^2}{-e}\langle\,\Psi^*\,|\,\beta\,\alpha_j\,|\,\Psi\,\rangle; \quad and \quad \langle\,\check{\phi}\,\rangle = \frac{m.C^2}{-e}\langle\,\Psi^*\,|\,\beta\,|\,\Psi\,\rangle; \tag{35}$$

There exists a physical cause and a mathematical possibility for obtaining the RslSlfCns values (31) of the ElcInt $\check{E}_j$ and the MgnInt $\check{H}_j$ from the four components in eqs.(35) of their vector-potential $\check{A}_j$ and potential $\check{\phi}$ by means of the corresponding relations between analogous ones of that, expressing the Maxwell's laws within the Maxwell's ClsElcDnm. For that purpose we have to exchange the coordinate operators ∇_j and time operator $\frac{1}{C}\frac{\partial}{C\partial t}$ in the Maxwell's ClsElcDnm's scheme, where the ElcChrg McrPrt's motion is described by its coordinate r_j, by the matrix operators $i\frac{mC}{\hbar}\alpha_j$ and $\frac{mC}{\hbar}\hat{I}$, when the FnSpr ElmElcChrg's motion is described by the matrices, in accordance with the relations (26), (27), (29), (30), and (31). Indeed, then instead of the Maxwell's relations :

$$H_j = [\nabla \times A]_j = \varepsilon_{jkl}\nabla_k A_l; \tag{36}$$

and

$$E_j = -\frac{1}{C}\frac{\partial A_j}{\partial t} - \nabla_j\phi \tag{37}$$

we must write the following unusual equations :

$$\check{H}_j = i\,\varepsilon_{jkl}\frac{mC}{\hbar}\alpha_j\frac{mC^2}{-e}\alpha_l = 2\frac{m^2C^3}{e\,\hbar}\sigma_j; \tag{38}$$

and

$$\check{E}_j = i\frac{mC}{\hbar}\hat{I}\frac{mC^2}{-e}\alpha_j - i\frac{mC}{\hbar}\alpha_j\frac{mC^2}{-e}\hat{I} = 0; \tag{39}$$

There is a necessity to note here that the presence of the matrices in the (31) is connected with the physical reason that the moment RslSlfCns values of the potential and vector-potential in the time t_1 are results of the interference of the QntElcMgnFlds of all Hgh-Enr StchVftPhtns, emitted in the time interval $(t_1 - \frac{T}{2}) \le t \le t_1$. It is easy to be shown in Veile's symmetrical representation, where the matrices γ_j and γ_o play the parts of the matrices α_j and β, participating in the Pauli-Dirac's representation.

As a consequence of our felicitious supposition, using by me at building of our PhsMdl, we may write the LnrDfrWvEqnPrtDrv of Dirac by means of the expression (35) for the RslSlfCns values of the own potential $\check{\phi}$ and vector-potential $\check{A}_j$ of the DrEl's FnSpr ElmElcChrg and its corresponding current in the following form :

$$\langle\,\Psi^+,\,|\,H_d\,|\,\Psi\,\rangle = -e\,\langle\,\Psi^+\,|\,\Psi\,\rangle\frac{m.C^2}{-e}\langle\,\Psi^+\,|\,\beta\,|\,\Psi\,\rangle +$$

$$e\,C\,\langle\,\Psi^+\,|\,\alpha_j\,|\,\Psi\,\rangle\frac{mC}{e}\langle\,\Psi^+\,|\,\beta\,\alpha_j\,|\,\Psi\,\rangle + C\,\langle\,\Psi^+\,|\,\alpha_j\,P_j\,|\,\Psi\,\rangle; \tag{40}$$

Then if we take into account the existence of the following equations:

$$\langle \Psi^+ | \Psi \rangle = 1; \qquad \text{and} \qquad \langle \Psi^+ | \alpha_j | \Psi \rangle \langle \Psi^+ | \beta \alpha_j | \Psi \rangle = 0; \qquad (41)$$

then the LnrPrtDfrWvEqn of Dr. The (40) may be rewritten into the following well-known form:

$$\langle \Psi^+ | H_d | \Psi \rangle = C \langle \Psi^+ | \alpha_j P_j | \Psi \rangle + m C^2 \langle \Psi^+ | \beta | \Psi \rangle \qquad (42)$$

Our investigation shows the role of each component of the TtlWvFnc Ψ of the DrEl at the description of its behaviour and the role of the matrixes as useful switches, making possible the description of the DrEl's motion by means of its four-component TtlWvFnc. Because of such our interpretation of the space-time dependent part of the SchEl's one-component OrbWvFnc Ψ, which gives the description of its orbital motion only, one could be compared with black and white TV, while the space-time dependent part of the DrEl's four-components TtlWvFnc Ψ, which together with matrices give the description of its full motion, one should be compared with color TV. In other words, while one-component OrbWvFnc ψ give us the colourless description only of the SchEl's motion, while the four-components TtlWvFnc Ψ together with matrices give diversiform of the coloured description of the DrEl's motion.

The existence of the well-known relativistic relation $E^2 = P^2 C^2 + m^2 C^4$ between the energy, momentum and mass of a real elementary particle (ElmPrt) also may be obtained by the Maxwell equations of the ClsElcDnm, taking into consideration the MgnInt between the momentum of the charged ClsMcrPrt and the vector-potential of its ClsElcMgnFld, participating in the IstThrDmnNrlQnt StchBsnVrtHrmOscMtn

In the long run I cherish hope that our consideration of the massive leptons' behaviour from a new point of view of my felicitous PhsMdl, physically obvious expatiating the physical cause for the origin of all their properties, will be of great interest for all scientists. Theoretical physicists will find the picturesque explanation of all their properties and Philosophers will find the total employment of the dialectical materialism for the investigations of the micro particle's world. My very quality and profound interpretation of the SchEl's behaviour in the NrlQntMch and of the DrEl's behaviour in the RltQntMch, as well as the excellent quantity coincidence of the deduced values of all DrEl's parameters with their corresponding experimentally determined values gives as the hope for correctness of our beautiful, simple and preposterous PhsMdl and fine, extraordinary ideas, which have been inserted at its construction.

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